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10/773,187	02/09/2004	Kia Silverbrook	MTB31US	8432

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393 DARLING STREET
BALMAIN, 2041
AUSTRALIA

EXAMINER	
FIDLER, SHELBY LEE	

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2861	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/773,187	SILVERBROOK, KIA	
	Examiner	Art Unit	
	SHELBY FIDLER	2861	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 January 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4-19,22-38 and 41-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4-19,22-38 and 41-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/25/2007*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Art Unit: 2861

DETAILED ACTION

Responsive Office Action

This Office Action is responsive to the remarks and amendments filed 1/22/2008.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 10/25/2007 has been considered by the examiner.

Claim Objections

Claims 12 and 31 are objected to because of the following informalities: please change "each element" (e.g. line 1 of claim 12) to "each heater element" to conform to the anteceding "heater element" disclosed in the independent claims. Appropriate correction is required.

Double Patenting

Claim 1 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 1 of U.S. Patent No. 7278716 in view of Manaka (JP 07-05943).

Regarding claims 1, 19, and 38:

Claim 1 of U.S. Patent No. 7278716 discloses all claimed limitations except that an ejectable liquid inlet and the nozzle aperture are aligned such that they have a common central axis, and

the heater element has two bubble nucleation regions that are laterally offset from the central axis, wherein the lateral offset of one of the bubble nucleation regions is equal and opposite to the lateral offset of the other bubble nucleation region.

However, Manaka disclose a printhead in which an ejectable liquid inlet (section of ink feeding channel 14 directly below ink chamber 13 as shown in Fig. 18) for establishing fluid communication between a nozzle aperture and an ejectable liquid supply (page 14, lines 14-16), the ejectable liquid inlet and the nozzle aperture being aligned such that they have a common central axis (Fig. 18); and heater elements (heater element 12) comprising two bubble nucleation regions (top and bottom regions of heating part 16a – Fig. 13), wherein the two bubble nucleation regions also being laterally offset from the central axis (Figs. 13 & 18), the lateral offset of one of the bubble nucleation regions being equal and opposite to the lateral offset of the other bubble nucleation region (Figs. 13 & 18). Manaka teaches that such a printhead configuration reduces power consumption and improves thermal efficiency (page 7, lines 20-24).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize the heater configuration disclosed by Manaka into the printhead disclosed by claim 1 of U.S. Patent 7278716.

Regarding claims 6, 8, 10-18, 25, 27, 29-37, 43, 44, and 46-54:

These claims are rejected as shown by the following table:

Claim # of Instant Application 10/773187	*Claim # of U.S. Patent 7278716 B2*
6, 25, 43	7
8, 27, 44	9

10, 29, 46	10
11, 30, 47	11
12, 31, 48	12
13, 32, 50	13
14, 33, 49	14
15, 34, 51	15
16, 35, 52	16
17, 36, 53	17
18, 37, 54	18

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 4-5, 7, 11-13, 16, 19, 22-24, 26, 30-32, 35, 38, 41-42, 47-48, 50, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka (JP 07-05943) in view of Whitman (US 6213587 B1).

Regarding claims 1, 19, and 38:

Manaka discloses an ink jet printhead comprising:

a plurality of nozzles (nozzle holes 12a), each nozzle having a nozzle aperture (Fig. 18);

a bubble forming chamber (ink chamber 13) corresponding to each of the nozzles respectively (Fig. 18);

an ejectable liquid inlet (section of ink feeding channel 14 directly below ink chamber 13 as shown in Fig. 18) for establishing fluid communication between the nozzle aperture and an ejectable liquid supply (page 14, lines 14-16), the ejectable liquid inlet and the nozzle aperture being aligned such that they have a common central axis (Fig. 18);

a heater element (heater element 16) disposed in each of the bubble forming chambers respectively (Fig. 18), the heater element having two bubble nucleation regions (top and bottom regions of heating part 16a – Fig. 13) suspended within the bubble forming chamber in a plane that is parallel to that of the nozzle aperture (Figs. 17-18) such that, in use, a layer of an ejectable liquid is between the plane of the two bubble nucleation regions and that of the nozzle aperture (page 11, lines 13-22 & Figs. 4b-4c), the two bubble nucleation regions also being laterally offset from the central axis (Figs. 13 & 18), the lateral offset of one of the bubble nucleation regions being equal and opposite to the lateral offset of the other bubble nucleation region (Figs. 13 & 18), such that

heating the heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble (17) that causes the ejection of a drop of the ejectable liquid through the nozzle aperture corresponding to that heater element (page 10, lines 3-10); wherein

the bubble nucleation regions are spaced from each other such that bubbles nucleated at each will grow until they unite to form the gas bubble that causes the ejection of a drop of ejectable liquid (page 11, lines 13-17).

Manaka does not expressly disclose that the plane on which the heater element is suspended is less than 5 microns from the nozzle aperture.

However, Whitman discloses that heater elements should be kept at a distance of about 8 microns to about 27 microns away from a nozzle plate (col. 8, lines 9-13), since such a separation distance greatly improves printhead reliability (col. 15, lines 48-52).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to suspend Manaka's heater element on a plane that is less than 5 microns from the nozzle aperture, since a separation distance of less than 5 microns falls within the disclosed range of "about 8 microns to about 27 microns."

Regarding claims 4, 7, 22, 26, and 41:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that the heater element is formed predominantly from titanium nitride (page 5, lines 9-11).

Regarding claims 5, 24, and 42:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that the bubble forming liquid and the ejectable liquid are of a common body of liquid (page 11, lines 14-22 & Figs. 4b-4c).

Regarding claims 11, 30, and 47:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that each heater element (16) has two opposite sides (the top and bottom sides of heating part 16a shown in Fig. 13) and is configured such that the gas bubble (17) formed by that heater element is formed at both sides of that heater element (page 11, lines 14-22 & Fig. 13).

Regarding claims 12, 31, and 48:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, but **Manaka as modified by Whitman does not expressly disclose** that the bubble that each heater element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

However, Campbell et al. teach that each bubble (bubble 22) formed by a heater element (heater elements 12) collapses to a point (col. 3, lines 14-19), and that a heater element having a small opening, such as that disclosed by Manaka, forms a bubble that collapses to a point that is spaced away from the heater element (col. 3, lines 14-19).

Therefore, Campbell et al. teach that the heater element of Manaka as modified by Whitman discloses all claimed limitations.

Regarding claims 13, 32, and 50:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that the printhead comprises a structure (cover plate 12), wherein nozzles are incorporated on the structure (Fig. 18).

Examiner notes the additional limitation that the structure is formed by CVD. However, this limitation concerns a method of forming the structure, which is not germane to the patentability of the structure itself. Because the structure, as claimed, can be formed by a variety of other methods, this limitation has not been given patentable weight.

Regarding claims 16, 35, and 52:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that the heater element (12) includes a solid material more than 90%

of which is constituted by at least one periodic element having an atomic number below 50 (TiN – page 5, lines 9-11).

Regarding claim 23:

Manaka as modified by Whitman disclose all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that the system is configured to support the bubble forming liquid in thermal contact with each heater element, and to support the ejectable liquid adjacent each nozzle (page 11, lines 10-22).

Claims 6, 10, 14, 25, 29, 33, 43, 46, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Whitman, as applied to claims 1, 19, and 38 above, and further in view of Silverbrook (US 6019457).

Regarding claims 6, 25, and 43:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that the printhead is configured to print on a page (page 6, lines 3-5).

Manaka as modified by Whitman does not expressly disclose that the printhead is a page-wide printhead.

However, Silverbrook discloses that printheads (heads 200) configured to be page-wide printheads (col. 6, lines 7-12), are capable of printing on the width of an A4 page in a single printing scan (col. 6, lines 7-12).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to configure Manaka's printhead to be a page-wide printhead.

Regarding claims 10, 29, and 46:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that the printhead comprises a substrate (cover plate 12).

Manaka as modified by Whitman does not expressly disclose that the areal density of the nozzles relative to the substrate exceeds 10000 nozzles/cm^2 of substrate surface.

However, Silverbrook discloses a printhead comprising a substrate surface, and that forming the printhead to have a nozzle density relative to the substrate surface greater than 12207 nozzles/cm^2 (using the reference measurement of Fig. 43) allows the printhead to print up to 16 drops per pixel (col. 16, lines 60-62).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to configure the printhead of Manaka as modified by Whitman to have a nozzle density exceeding 10000 nozzles/cm^2 relative to the substrate surface.

Regarding claims 14, 33, and 49:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Manaka also discloses** that the printhead comprises a structure (cover plate 12), wherein nozzles are incorporated on the structure (Fig. 18).

Manaka as modified by Whitman does not expressly disclose that the structure is less than 10 microns thick.

However, Silverbrook discloses that providing a structure (overcoat 142) that less than 10 microns thick (col. 9, lines 8-10) onto a nozzle plate provides increased levels of protection against the air (col. 9, lines 5-8).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize an overcoat, such as disclosed by Silverbrook, onto the cover plate of Manaka as modified by Whitman.

Claims 9, 28, and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Whitman, as applied to claims 1, 19, and 38 above, and further in view of Hara et al. (US 4376945).

Regarding claims 9, 28, and 45:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, but **Manaka as modified by Whitman does not expressly disclose** that the heater elements are configured such that the energy required to cause ejection of the drop is less than the energy required to heat a volume of the ejectable liquid from ambient temperature to the boiling point.

However, Hara et al. disclose a printhead (recording head 109) that is configured to receive a supply of ejectable liquid at an ambient temperature, and that preheating the printhead (recording head 109) to within 2-3 degrees below the boiling point requires less energy to eject a droplet (col. 31, lines 19-21, 26-29), thus improving the energy efficiency of the printhead (col. 30, lines 12-17).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to preheat the printhead of Manaka as modified by Whitman such that the energy required to cause ejection of the drop is less than the energy required to heat a volume of the ejectable liquid equal to a volume of the drop from ambient temperature to the boiling point.

Claims 15, 18, 34, 37, 51, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Whitman, as applied to claims 1, 19, and 38 above, and further in view of Kubby (US 5706041).

Regarding claims 15, 34, and 51:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, and **Whitman also discloses** that the printhead comprises a plurality of nozzle chambers (page 7, lines 10-14) each corresponding to a respective nozzle (Fig. 18).

Manaka as modified by Whitman does not expressly disclose that a plurality of the heater elements are disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

However, Kubby discloses a plurality of heater elements (doped regions 20a & 20b) disposed within each chamber (Fig. 4), wherein the heater elements within each chamber are formed on different respective layers (col. 4, lines 26-55). By providing such a heater configuration, Kubby teaches that the printhead is capable of emitting droplets of two distinct droplet sizes (col. 4, lines 56-66).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to provide two heater elements on different respective layers, such as disclosed by Kubby, into the invention of Manaka as modified by Whitman.

Regarding claims 18, 37, and 54:

Manaka as modified by Whitman discloses all the limitations of claims 1, 19, and 38, but **Manaka as modified by Whitman does not expressly disclose** that each heater element has a conformal protective coating on any parts exposed to the bubble forming liquid, the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless.

However, Kubby discloses covering each heater element (polysilicon layers Poly1 & Poly2) with a conformal protective coating (Tantalum protective layer) on all sides of the heater element such that the coating is seamless (col. 4, lines 13-22 and Fig. 4). Kubby teaches that such

a coating prevents corrosion of the semiconductor structures from contact with ink (col. 4, lines 13-22).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a protective coating on all sides of the heater elements disclosed by Manaka as modified by Whitman.

Claims 17, 36, and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manaka as modified by Whitman, as applied to claims 1, 19, and 38 above, and further in view of DeMoor et al.

Regarding claims 17, 36, and 53:

Manaka as modified by Whitman disclose all the limitations of claims 1, 19, and 38, but **Manaka as modified by Whitman does not expressly disclose** that the heater elements are configured for a mass of less than 10 nanograms to be heated to cause ejection of a drop.

However, DeMoor et al. disclose that forming heater elements comprising a mass of less than 10 nanograms (page 285, Fabrication: Ti thickness = 5nm; TiN thickness = 30nm; heater width = 2000μm; heater width = 0.4μm. Therefore, the volume of Ti within the heater is $4*10^{-12}$ cm^3, and the volume of TiN within the heater is $2.4*10^{-11}$ cm^3. Using the known densities of Ti = 4.54 g/cm^3 and TiN = 5.22 g/cm^3, the heater element has an entire mass of 0.14344 ng) shows excellent resistivity uniformity and low TCR values (page 293 - Conclusions).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to form the heater elements of Manaka as modified by Whitman heater of less than 10 nanograms of solid material, which serves to heat the bubble forming liquid above the boiling point.

Allowable Subject Matter

Claims 8, 27, and 44 would be allowable if rewritten to overcome the Double Patenting rejection(s) set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

Claim 8 contains allowable subject matter since the prior art of record does not disclose, teach, or suggest an ink jet printhead comprising a heater element that is configured such that an actuation energy of less than 500 nanojoules is required to form the bubble to cause the ejection of the drop. It is this limitation, in combination with other features and limitations of claim 8, that makes this claim allowable over the prior art of record.

Claim 27 contains allowable subject matter since the prior art of record does not disclose, teach, or suggest a printer system incorporating a printhead comprising a heater element that is configured such that an actuation energy of less than 500 nanojoules is required to form the bubble to cause the ejection of the drop. It is this limitation, in combination with other features and limitations of claim 27, that makes this claim allowable over the prior art of record.

Claim 44 contains allowable subject matter since the prior art of record does not disclose, teach, or suggest a method of ejecting drops of an ejectable liquid comprising the step of heating the at least one heater element by applying an actuation energy of less than 500 nanojoules. It is this limitation, in combination with other features and limitations of claim 44, that makes this claim allowable over the prior art of record.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Silverbrook (US 5796416), for example, discloses heater elements that form a droplet with an actuation energy of less than 500 nanojoules. However, because actuation energy is

directly dependent upon the structure and configuration of the heater element, it would be improper to assume that the heating pulse disclosed in Silverbrook would actuate Campbell et al.'s heater element to produce a drop.

Response to Arguments

Applicant's arguments with respect to claims 1, 19, and 38 have been considered but are moot in view of the new ground(s) of rejection. Please see the above obviousness rejections based on the disclosures provided by Manaka and Whitman.

Applicant's arguments, concerning the inclusion of 5 microns, have been fully considered but they are not persuasive. Whitman discloses providing a heater to nozzle plate spacing of about 8 microns to about 27 microns. Because this range is not limited to only the distances between 8 and 27 microns, an obvious variation of this teaching would allow a spacing of less than 5 microns. Therefore, the invention of Manaka as modified by Whitman properly discloses all claimed limitations.

Art Unit: 2861

Communication with the USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SHELBY FIDLER whose telephone number is (571)272-8455. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Luu can be reached on (571) 272-7663. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Shelby Fidler/
Patent Examiner
AU 2861

/LUU MATTHEW/

Supervisory Patent Examiner, Art Unit 2861